



# **Costs and Benefits of Electricity Subsidies in Uganda**

A Dissertation

presented to

The Graduate School of Business  
University of Cape Town

In partial fulfilment  
of the requirements for the  
**Master of Philosophy in Development Finance Degree**

by

**Charles Victor Byaruhanga**

**Supervisor:** Professor Paul Alagidede

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

## **PLAGIARISM DECLARATION**

I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.

I have used a recognised convention for citation and referencing. Each significant contribution and quotation from the works of other people has been attributed, cited and referenced.

I certify that this submission is my own work.

I have not allowed and will not allow anyone to copy this essay with the intention of passing it off as his or her own work

**Charles Victor Byaruhanga**

## **ABSTRACT**

Electricity subsidies in Uganda have been pervasive in support of industrial output and government revenues since 2005, until their reduction in January 2012. While economic theory suggests that market mechanisms maximise social welfare, the necessity for subsidies arises when a markets fail. However, market failure alone is not a sufficient condition to provide subsidies, as they are costly, and therefore have to be properly targeted and justified. This research seeks to establish the relationship between electricity subsidies, on the one hand and industrial output and government revenues in Uganda. It also attempts to ascertain the equitability of the electricity subsidy policy.

Information and data was gathered from secondary sources in Uganda on electricity subsidies, industrial output and revenues during the period 2005 to 2012. For an empirical investigation of the costs and benefits of electricity subsidies in Uganda, certain logical relationships are identified in the study to guide the empirical investigation and the analyses. It is assumed that government revenues were dependent on electricity subsidies and industrial output during the period under investigation, in order to maintain social welfare. It was also argued that the maintenance of industrial output through electricity subsidies support was justified given that about one third of Uganda total revenues are contributed by the manufacturing sub-sector. To ascertain the extent of vertical equity, the research also investigated the benefit incident of electricity subsidies, from a macro-level standpoint. This is pertinent given that only 11 per cent of Ugandans have access to grid-power and electricity use favours higher income, urban end-users.

Secondary data on excise and corporate tax collections and electricity subsidies provided to end-users in Uganda during period are statistically analysed for relational effects using Ordinary Least Square regression models. The respective estimators in the relationship reveal

very strong relationships between excise and corporate tax revenues, on the one hand, and electricity subsidies. Electricity subsidies were found to be positively related to both excise and corporate tax revenues and industrial output during the period under study. From the evidence, the overall objective of the electricity subsidy policy seems to have been attained, in as far as revenues base was protected and industrial output was maintained. The evidence also reveals that at a macro-level, end-user beneficiaries of subsidies in the manufacturing sub-sector continued to make profits, enabling them meet their corporate tax obligations.

# TABLE OF CONTENTS

PLAGIARISM DECLARATION .....	i
ABSTRACT.....	ii
TABLE OF CONTENTS.....	iv
LIST OF FIGURES AND TABLES .....	vi
GLOSSARY OF TERMS .....	vii
ACKNOWLEDGEMENT .....	viii
1 INTRODUCTION.....	1
1.1 Overview of Uganda’s Electricity Sector .....	3
1.2 Research Area .....	5
1.3 Problem Statement.....	6
1.4 Purpose and Significance of the Research .....	8
1.5 Research Questions and Scope.....	10
1.6 Research Assumptions .....	10
2 LITERATURE REVIEW .....	12
2.1 Introduction.....	12
2.2 Economic Theory and Electricity Subsidies .....	12
2.3 Market Mechanisms, Social Welfare and Subsidies .....	15
2.4 The Energy-Income Nexus .....	16
2.5 Perfect Market Mechanisms Deficiencies and the Electricity Market.....	16
2.6 Balancing Costs and Benefits of Subsidies .....	17
2.7 Developing Country experiences with Electricity Subsidies .....	17
2.8 Equity and Subsidies .....	19
2.9 Definition and Characteristics of Subsidies .....	20
2.10 Conclusion .....	21
3 RESEARCH METHODOLOGY .....	22
3.1 Research Approach.....	22
3.2 Research Strategy and Design.....	22
3.3 Model Estimation .....	24
3.3.1 Model 1: Excise Tax Revenues and Electricity Subsidies .....	24
3.3.2 Model 2: Corporate Tax Revenues and Electricity Subsidies .....	26
3.4 Data Collection, Frequency and Choice of Data .....	27
3.5 Sampling .....	28
3.6 Data Analysis .....	29

3.7	Limitations .....	30
4	RESEARCH FINDINGS, ANALYSIS AND DISCUSSION .....	32
4.1	Introduction.....	32
4.2	Descriptive Statistics .....	32
4.3	Effects of Electricity Subsidies on Excise Tax Revenues.....	36
4.3.1	Model 1's Empirical Results .....	36
4.3.2	Test of Model 1's Validity .....	38
4.4	Effects of Electricity Subsidies on Corporate Tax .....	39
4.4.1	Model 2's Empirical Results .....	39
4.4.2	Test of Model 2's Validity .....	40
5	RESEARCH CONCLUSIONS .....	42
6	RECOMMENDATIONS FOR FUTURE RESEARCH .....	43
	REFERENCES.....	44
	APPENDICES.....	46
	Appendix 1: Regression Results of Excise Tax Revenues, Industrial Sales and Electricity Subsidies .....	47
	Appendix 2: Regression Results of Corporate Income Tax Revenues and Electricity Subsidies .....	48
	Appendix 3: Quarterly Data used for Model 1 .....	49
	Appendix 4: Annual Data Used in Model 2 .....	50

## **LIST OF FIGURES AND TABLES**

### **LIST OF FIGURES**

**Figure 1:** Quarterly Excise Tax Revenue

**Figure 2:** Annual Corporate Tax Revenue

**Figure 3:** Index of Industrial Production

**Figure 4:** Industrial Electricity Sales

**Figure 5:** Total Tariff Subsidy

### **LIST OF TABLES**

**Table 1:** Model 1 Summary Statistics

**Table 2:** Regression Results using Excise Taxes

**Table 3:** Regression Results using Corporate Taxes



## GLOSSARY OF TERMS

BOT	–	Build Operate Transfer
BoU	–	Bank of Uganda
CTR	–	Corporate Tax Revenue
ERA	–	Electricity Regulatory Authority
ES	–	Electricity Subsidies
ETR	–	Excise Tax Revenue
GDP	–	Gross Domestic Product
GWhrs	-	Giga Watt Hours
IES	–	Industrial Electricity Sales
IOP	–	Index of Industrial Production
IPP	–	Independent Power Producer
MFPEd	–	Ministry of Finance, Planning and Economic Development
MEMD	–	Ministry of Energy and Mineral Development
MWhrs	-	Mega Watt hours
UBOS	–	Uganda Bureau of Statistics
URA	–	Uganda Revenue Authority

## ACKNOWLEDGEMENT

In carrying out this research and throughout undertaking the study programme, I am indebted to a number of individuals, for whom this work would not have been possible. I acknowledge my supervisor Professor Paul Alagidede for the guidance and wise counsel in both the initiation of the area of research, and throughout the period I undertook the research. The study was the climax of an expedition to understanding the fundamental intricacies of academic thought behind the practical world, for which I am grateful to my erstwhile *alma mater*.

I am also eternally indebted to my family, especially my wife Irene, whose patience, support and encouragement I received, which inspired me to persist throughout the study programme.

## **1 INTRODUCTION**

Uganda experienced disruption in electricity supply during 2005, as a result of a severe decline in electricity supply generation. The decline in electricity supply was a result of a significant decline in hydro power generation, which contributed 99.9 per cent of total electricity supply (Bank of Uganda, 2006, p. 99). Hydropower generation had been severely constrained as a result of increased drought that beset the entire East African region since 2002.

The drought led to constraints in electricity supplied from existing relatively cheaper hydropower generation sources that Uganda traditionally relied on. The impact of the drought was subsequently evident with increased power blackouts. The number of industrial consumers consequently declined, on a year-on-year basis, by 5.5 per cent and 85.4 per cent in 2004 and 2005 respectively (Ministry of Finance, Planning and Economic Development, 2011, p. 6).

It was anticipated that a decline in electricity supply would lead to a reduction in industrial output, and consequently negatively impact government revenues. Government was therefore prompted to intervene to stem the anticipated loss in industrial output and revenues by putting in place emergency power generation measures. Other economy-wide implication of the electricity supply shortfall included a possible spiral impact with a decline in the supply of goods, increasing price inflation and a deterioration in the overall performance of the economy.

The Uganda government was forced to contract privately operated petroleum-based electricity generation plants to mitigate electricity shortages, which substantially increased

electricity supply costs. Increased supply from the more expensive emergency power plants, without a commensurate increase in electricity tariffs, also required government to provide end-user subsidies. Even though end-user electricity tariffs were increased successively in 2005 and 2006, the increases were not sufficient to meet electricity supply costs entirely. Government believed that the institution of fully cost-reflective tariffs would have led to significant political, social and economic shocks. It is noteworthy that substantial lobbying and pressure by industrialists and other consumers to reduce tariffs gained ground, subsequently leading to Government temporarily reducing electricity tariffs in January 2009.

As a result of the reduction in tariffs without a commensurate lowering of the costs of electricity supply generation, the Government's obligation to provide subsidies to the electricity sector increased. In order to prevent haemorrhage of the public purse as a result of increasing financing shortfalls in the electricity sector, Government was compelled to increasing tariffs in March 2011.

Government's provision of direct budget subsidies effectively lasted from June 2005 until March 2011, in addition to the provision of tax rebates for fuel used in thermal electricity generation plants. The increase in electricity tariffs and reduction in the provision of direct budget subsidies was only possible upon the increase of significant hydro power generation supply from the 250 MW Bujagali Hydropower Project, which source was cheaper than the petroleum based generation plants.

The return to reliance on hydro-power based sources of electricity supply reduced electricity supply costs significantly, although fully cost reflective end-user tariffs were not

instituted. Arguments against instituting fully cost-reflective electricity tariffs were premised on maintaining similar tariffs for Ugandan consumers, comparable to those paid by end-users in neighbouring countries. This argument was particularly advanced by industrial and private sector players who contended that they would be less competitive with competitors from neighbouring countries and thus be forced out of business. It is evident that an in-depth assessment of subsidy policy was required to understand its costs, benefits and trade-offs.

The study therefore attempts a critical assessment of Uganda's electricity subsidy policy between 2005 and 2011 in order to contribute to understanding its costs, benefits and trade-offs. An explanation of the rationale for the electricity subsidy policy from an empirical and theoretical standpoint, seeks to enable policy makers understand why and when electricity subsidies should be necessary, and how best to implement subsidy interventions, if at all it is necessary, in the future.

## **1.1 Overview of Uganda's Electricity Sector**

Electricity use in Uganda is highly limited, with only a 12% national grid electrification rate being recorded in 2011 (Ministry of Energy, 2011). Furthermore, given that Uganda's urbanisation rate is only 14.6 per cent, a vast majority of the population are rural based and are relatively poorer than urban Ugandans (UBOS, 2012]. A key characteristic of the electricity sector in Uganda with respect to use is that it is concentrated in urban and relatively wealthier households of the population.

Electricity use in Uganda is also mostly used by industrial consumers, who accounted for 64 per cent electricity consumption in 2012 (Electricity Regulatory Authority, 2012). Commercial and household electricity consumers accounted for 12 and 24 per cent respectively. This reveals that the industrial sector is the most significant in terms of electricity consumption.

Before the onset of the electricity crisis in 2004, Uganda's main source of electricity was from hydropower generation (Bank of Uganda, 2006, p.99). The total national electricity generation capacity amounted to 1,895.6 GWhrs in 2004, with the hydropower generation contributing 1,894.5GWhrs, equivalent to 99.9 per cent of total electricity generation.

As a result of delays in the construction of planned hydropower based electricity generation capacity, unprecedented power shortages occurred. It was evident that this would negatively impact on government revenues, economic growth and ultimately constrain the achievement of the Government's socio-economic objectives. In response, Independent Power Producers (IPPs) were contracted by Government to install thermal fuel based electricity generation plants on an emergency basis. These plants supplied electricity significantly more expensive than from hydro-power sources; which substantially increased electricity supply costs. Government was compelled to extend direct subsidies from the budget to electricity consumers, in addition to tax rebates being provided to petroleum based electricity generation. This intervention was based on the premise that fully cost reflective tariffs incorporating the entire increase in electricity supply costs could not be implemented, without severe political and socio-economic consequences.

## **1.2 Research Area**

The research is theoretically founded in the theory that competitive market mechanisms deliver society welfare benefits most efficiently. The general competitive market equilibrium theory proved by Kenneth Arrow and Gerard Debreu (1954), as cited in Amagashie (2006, p. 7) holds that a perfect market, with players having the same set of information and facts, leads to competitively determined prices. The theory concludes that competitively determined prices ultimately provide maximum welfare benefits as society pays the price accordingly to its desire for the product. This state represents Pareto optimality.

This argument supposes that interventions, such as the provision of electricity subsidies, which lead to pre-determined price levels, reduce the benefits to society, representing inefficiency and the lack of Pareto optimality. Competitive market equilibrium theory therefore, suggests that subsidies are costly to society and inefficient.

However, an alternative theory holds that in the presence of incomplete or imperfect markets, private markets fail to provide goods desired by consumers (Stiglitz, 2000). This school of thought argues that market failures sometimes necessitate Government intervention to move production to the maximum production frontier that reflects maximum societal benefit. The market pricing mechanism in this instance would have failed to ensure that societal benefits are maximized.

The electricity supply shock that Uganda experienced in 2005 can be considered a case of market failure as new investments to replace declining supply could not be made instantaneously without significant increases in end-use tariffs. The research therefore

seeks to investigate the evidence of the benefits or otherwise of electricity subsidies in Uganda as far as increasing social welfare, in the face of market failure.

From an equity and distributional standpoint, the provision or removal of subsidies has been noted to have significant consequences for social welfare (Dufty, 2007). While this may hold in instances where electricity subsidies directly benefit significant segments of the population, the electricity subsidy policy in Uganda was largely directed to industrial end-user consumers. This was regarded as an intermediate point of intervention to ensure stability in the provision of goods to the general populations and the sustenance of government revenues. However, the efficacy of such a modality in delivering benefits equitably is in doubt, if significant profits were to be made from industrial firms which were supported by subsidies.

### **1.3 Problem Statement**

Electricity subsidies were necessitated by drought in 2005 which severely reduced hydropower generation capacity, the major source of electrical power in Uganda, while electricity demand continued to grow. The provision of subsidies to the Uganda electricity sector has since been largely regarded as an unnecessary drain on budgetary resources, given the significant opportunity costs for public spending. This is particularly evident from the relative magnitude of direct budget subsidies provided to electricity consumers. An estimated US\$ 800 million – US\$ 1 billion was spent on direct budget subsidies to electricity consumers between 2005 and 2011. This constitutes a significant amount, Uganda being a relatively small economy with an estimated GDP of USD 20 billion in 2012 (UBOS, 2012). In comparison, the thirty-year Build Operate Transfer (BOT) 250 MW Bujagali Hydropower Project whose construction was completed in 2011 and added



almost 50% to Uganda's generation capacity, was estimated to cost USD 900 million (International Finance Corporation, p. 2).

Direct electricity subsidies therefore constituted significant budget resources that could have alternatively been allocated towards other priority public expenditure areas in Uganda, including critical infrastructure investments and public service delivery. Significant resources that could have addressed the country's severe infrastructural deficits and other social service delivery needs were thus allocated to subsidies, for which rigorous justification is necessary.

The magnitude of direct subsidies to electricity consumers was exacerbated by the increase in global prices of crude oil and, later on, the rapid depreciation of the Uganda Shilling against international currencies. These exogenous factors occurred while electricity consumers continued to pay fixed tariffs in the local currency, consequently increasing the subsidy requirement. On a year to year basis, electricity subsidy requirement increased with increasing demand far in excess of supply, as no significant increase in electricity tariffs, commensurate with electricity supply costs, was instituted.

Consequently, the country was faced with increased blackouts and widespread electricity rationing, as Government failed to meet its electricity subsidy obligations. At the implementation of electricity subsidies in 2005, electricity shortages amounted to 40% of the total national installed capacity of 380 MW, with an effective output of only 120 MW compared to peak consumer demand of 260 MW (International Finance Corporation, p. 4).

While it was perceived that the absence of subsidies would have represented a significant shock to the Uganda economy in terms of lost production and a decline in public revenues, untargeted provision of subsidies represents inefficiencies as consumers able to pay higher electricity tariffs were not charged sufficiently high enough tariffs. This was especially so with given the skewed provision of electricity subsidies towards large industrial consumers, regardless of need.

#### **1.4 Purpose and Significance of the Research**

This study was country specific and was motivated by the need to undertake an empirical assessment of the costs and benefits of the relatively substantial electricity subsidies that were instituted in Uganda between 2005 and 2011. The electricity subsidy policy was pursued with the aim of sustaining economic production and government revenues in the face of a decline in electricity supply from traditional hydropower sources. Subsidies also arose from the need to shield increased electricity supply costs from consumers, as a result of reversion to alternative, but more expensive forms of power generation that could be quickly installed. The alternative sources of electricity supply were primarily petroleum-fuel thermal based and were consequently more expensive than the traditional sources from hydropower based generation.

The purpose of the research is therefore to study the relationship between electricity subsidies and Uganda's industrial output and government revenues. The research also attempts to ascertain the equitability of the electricity subsidization policy, as some of the target beneficiaries received disproportionately larger proportion of the subsidy, regardless of their respective ability to pay. The extent of inequity needs to be investigated from an empirical stand point, in light of the fact that industrial consumers received comparatively

larger shares of electricity subsidies, while they continued earned substantial profits, as evidenced from their ability to pay taxes on profits.

The increased perception that inequitable benefits accrued to beneficiaries of electricity subsidies, provides lessons, particularly for policy makers, in improving both the timing and targeting of electricity subsidies. This is in the likelihood that Uganda was to face electricity supply shocks in the future. The shocks would arise as power supply from cheaper generation sources is outstripped by growth in consumer demand, as cheaper renewable electricity infrastructure investments have long gestation periods and suffer delays in implementation, largely due to bureaucratic impediments.

The study is premised on the rational that while the immediate necessity for subsidies was to alleviate rising costs for energy consumers, ensure continued economic production and protect Government revenues, there is an overriding need to ascertain the possible unintended consequences of the policy. This is pertinent in light of the opportunity costs for the alternative use of limited government budgetary resources on relatively more deserving social services and infrastructure investments. Furthermore, the electricity subsidy policy may have encouraged less efficient use of electricity, leading to increased demand far beyond what it would have been had its end-user price been more cost reflective. The research therefore also hopes to draw lessons from the inappropriate targeting of electricity subsidies.

Electricity tariffs were subsequently increased in 2012 to more cost reflective levels in the midst of increasingly discerned opportunity costs of public resources spent on electricity subsidies. The research hopes to explore more effective mechanisms for dealing with

shocks in electricity supply that may compel government to institute electricity price subsidies in the future. This is relevant in view of the limited flexibility there is to quickly bring on-stream affordable sources of electricity generation capacity. It is envisaged that this research will elucidate better mechanisms that target and ensure the timing for electricity subsidies are both equitable and not onerous to other deserving public priorities, as the likelihood of shortfalls in electricity supply are envisaged in the long term.

### **1.5 Research Questions and Scope**

The objectives of the research are therefore twofold as detailed below:-

1. To establish the relationship between government revenues, industrial output and electricity subsidies; and
2. To provide an insight into the appropriateness of targeted electricity subsidies in the future

In order to achieve the research objectives enumerated above, the following research questions will be investigated in the Uganda context:-

1. What is the relationship between government revenues and electricity subsidies?
2. What is the relationship between industrial output and electricity subsidies?
3. Have electricity subsidies been equitable in light of the disproportionate incidence among electricity end users in favour of largely industrial electricity consumers?

### **1.6 Research Assumptions**

The research assumptions are that government revenues depend significantly on industrial output. This is predicated on the contribution of industries to government revenues, which

contribution amounts to 34 per cent of total revenues. Consequently, the industrial sector in Uganda received a larger portion of the subsidies over the period under investigation.

A further assumption made is that industrial output contributes to social welfare given the premise that the goods that are produced are socially desirable. It is also assumed that there is a significant relationship between electricity use and industrial output.

Furthermore, the working definition of subsidies in the proposed research includes only direct transfers from government, as a result of explicit budgetary allocations. This definition excludes subsidies provided through tax exemptions for fuel used in the generation of power from fossil fuel based electricity generation (Kitson, Wooders and Moerenhout, 2011, p. 6).

## **2 LITERATURE REVIEW**

### **2.1 Introduction**

General competitive economic theory postulates that subsidies are inefficient because the ultimate benefit to society is less than the social costs of the subsidy, in the absence of market failures or imperfections (Katz & Rosen, 1994). Accordingly, in the fundamental theorems of welfare economics, the first theorem is that an economy is Pareto efficient if it is competitive, among other conditions. (Stiglitz, 2000). Central to this theorem is that competitively determined market prices, under ideal conditions, lead to a Pareto optimal allocation of resources.

However, the presence of market failure or imperfection markets at least, justifies the use of subsidies to maximise social benefit (Ross, 1991; Grogan 2004). Therefore as a result of market imperfections or even failure, it can be argued that society's benefits from electricity consumption could only be maintained at increased costs of its supply. This would create positive electricity production externalities, without the producer being compensated for the increased costs. This consequently dis-incentivises the producer, resulting into lower and therefore a sub-optimal production of electricity, which would translate into lower benefits to society. This phenomenon is otherwise known as a "dead weight" loss to society and would justify the provision of a subsidy to electricity producers in order to mitigate increased costs of electricity production.

### **2.2 Economic Theory and Electricity Subsidies**

A large body of literature supports competitive general equilibrium theory that suggests that price subsidy interventions, such as public electricity subsidies, as are socially inefficient. Kerkela (2004, p.7) contends that the liberalization of electricity tariffs is critical to allow the market mechanism to attract investment in the sector. This suggests

that electricity markets are sufficiently efficient to allow free entry and exit of electricity producers and consumers at any given tariff levels. However, inordinately long equilibrium transmission mechanisms peculiar to energy markets reduces the efficiency of the market mechanism, as it takes substantial time for investment and consumption entry and/or exit decisions to be actually realized.

The transmission mechanism to equilibrium in electricity markets is a matter that is not taken cognisance of in the efficient market argument. Electricity producers require a considerable amount of time to fully execute investments in generation projects that translate into actual production of electricity, even for the smaller , comparatively lower cost and less complex projects.

Kosmos (1987, p. 8) maintains that the prevention of the attainment of cost reflective electricity prices, causes a drain on government resources, promotes excessive demand, and encourages resource depletion. This resonates with global experience given the tendency for governments which take a short term perspective to cost reflective prices. Governments in this respect would seek protect consumers from the actual costs of electricity they consume. Electricity consumers in this circumstance therefore have no incentive to maximize efficiency in the use of subsidized electricity, which they would perceive as a public good. This leads to a needlessly excessive demand for resources and consequently excessive resource depletion. This argument is reinforced by Ritschel and Smestad (2003) who contend that electricity consumers insulated from market prices will not adjust electricity use through conservation, which inevitably leads to supply shortages.

The absence of a longer term perspective to the cost of electricity subsidies by governments would ultimately reveal opportunity costs arising from maintenance of subsidies. Bacon, Ley and Kojima (2010, p. 7) confirm that large energy subsidies represent severe opportunity costs, as they preclude spending on other deserving services. The totality of subsidies provided to support electricity tariffs from a long term perspective, would reveal the extent to which deserved spending on high priority areas could have been undermined.

In addition to the burden on public finances, the United Nations (2003) notes that subsidies, stem the potential of economic growth as they weaken the foreign trade balance and undermine investment in the energy sector, while also impeding energy conservation as they discourage efficiency both in supply and demand through promotion of non-economic consumption of energy.

The foregoing body of literature suggests that electricity subsidies lower societal benefits and prominently places at the forefront, arguments for the removal of energy subsidies towards more cost reflective levels to encourage energy efficiency. Kerkela (2004, p. 11) therefore argues for reform in energy markets through removal of electricity subsidies, to enhance market competitiveness. All things equal, this should increase demand, reduce costs of production and costs of importation of fuel in case of fuel based electricity generation. This suggests that an economy becomes more efficient with fewer subsidies and therefore supports the argument that there would be higher societal benefits in line with the competitive general market equilibrium theory.



### **2.3 Market Mechanisms, Social Welfare and Subsidies**

In the presence of incomplete or imperfect markets, however, private markets fail to provide goods desired by consumers (Stiglitz, 2000). The market pricing mechanism in this circumstance does not ensure that societal benefits are maximized. Stiglitz, (2000) argues that this sometimes necessitates Government intervention to move production to the maximum production frontier that reflects maximum societal benefit. Market failure is depicted in instances where in the absence of sufficient supply of a good, less quantity of the good is produced compared to the quantity required by society. This consequently leads to higher prices being charged to establish market equilibrium, for which subsidies are necessary for a merit good, in order to allow prices to be reduced and greater quantities produced for increased societal benefit.

Furthermore, the General Theory of Second Best by Lipsey and Lancaster (1956), cited in Amegashie (2006), posits that any conditions that do not allow for a socially efficient level of production, or Pareto optimality, allows the violation of free market pricing principles. The conditions include imperfect or incomplete markets (Stiglitz, 2002), or conditions that present barriers to free entry (United Nations, 2003, p12). Violating market principles through provision of subsidies restores Pareto optimality, in order to increase social welfare.

Stiglitz (2002) however, notes that achieving efficient outcomes or socially desirable levels of production determined through competitive equilibrium market is precluded most especially in developing economies, given the restrictive conditions that drive ideal market models. The need to redistribute resources among individuals provides a justification for the role of the public sector in more developed economies, in addition to the restrictiveness of the ideal conditions. In developing countries, the pervasiveness of

constraints to the ideal conditions provides compelling arguments against over-reliance on the market mechanism to provide socially optimal welfare. The United Nations (2003, p.12) also argues that from a practical standpoint energy markets left on their own do not work perfectly and that subsidies can be justified if social welfare is increased.

## **2.4 The Energy-Income Nexus**

A body of literature also seeks to establish the casual relationship between energy consumption and economic growth. In an empirical study of Pakistan's energy-income nexus, Jamil and Ahamad (2010, p. 1) recount numerous studies that contend that energy is an essential source of economic growth because it complements other factors of production, or and alternatively literature that argues that energy consumption is neutral. Interestingly it reveals that notes that empirical work in several countries arrive at mixed results, emerging with neutral, bi-directional and uni-directional causality between the energy-income nexus.

## **2.5 Perfect Market Mechanisms Deficiencies and the Electricity Market**

Electricity markets are also prone to adjustment lags. Adjustment lags arise from delays in implementing investment decisions that would augment electricity supply more cheaply than emergency power options. The delay in increasing electricity supply, as a result of increased demand using the market mechanism is therefore constrained by the time it takes adjustments to mature. This is especially evident in cases of electricity generation where, investments are complex in nature and the size of electricity capacity being built requires substantial lead times.

The standard economic model that postulates an efficient market mechanism also suggests that prices consumers pay would vary as costs of producers change. From a demand

perspective, Borenstein and Holland (2003) contend that electricity markets are least inclined to behave as expected in standard market equilibrium theory of perfect markets as electricity prices paid by consumers cannot be adjusted as frequently to reflect changing costs of producing electricity. This is because electricity supply costs vary more frequently than end user prices can be changed, thus creating imperfect nature of electricity markets. This suggests that second best alternatives to the perfect market model need to be considered.

## **2.6 Balancing Costs and Benefits of Subsidies**

While the benefits of subsidies can be established in terms of increasing social welfare, their ultimate cost is a major consideration. This requires an evaluation of both the costs and benefits of any subsidy to ascertain the overall impact. Amegashie (2006) posits that while appropriately targeted subsidies increase social welfare, this benefit must be balanced by the subsidy's costs, broadly defined. It is noteworthy that even ardent opponents of electricity subsidies recognize that a host of factors, including revenue requirements, provide compelling political and economic reasons for the introduction of subsidies (Komos, 1987:7).

## **2.7 Developing Country experiences with Electricity Subsidies**

Numerous developing country-level studies have been undertaken that assess the impact of energy subsidies in general on poverty, inflation, growth, public revenues and industrial competitiveness. Hope & Singh (1995), undertook an empirical assessment of the impact of energy price removals in Malaysia, Indonesia, Ghana, Zimbabwe, Columbia and Turkey. They conclusively establish that the removal of energy subsidies significantly reduced that drain on public resources in the countries studied. In a more global

assessment of subsidies, the World Bank (2010) reveals that large energy subsidies compete for limited resources that could otherwise be used for other developmental needs.

Saboohi (1999), in an evaluation of the impact of reducing energy subsidies on living expenses of households in Iran, reveals that energy subsidies lead to market distortions and welfare losses. The additional financial resources would otherwise be available for allocation directly to competing needs, including the compensation for the decreased purchasing power of Iranian households incurring higher energy costs.

Hope & Singh (1995) further reveal that the impact of removing electricity subsidies on industrial firms in developing countries is modest, since energy costs as a share of total company expenses typically range from 0.5 to 3 percent with a typical value of 1.5 percent. In addition, they established that industrial firms were flexible enough to find substitutes when energy prices increase. The World Bank (2010) further confirms that subsidies promote non-economic consumption of energy, among other undesirable effects. The overall impact on industrial output revealed that industrial output increased even with higher energy prices, implying that the impact of higher prices was modest. They are, however, exceptions to this especially for energy intensive industries, for which energy constitutes a substantial portion of operating costs.

However, subsidies have been used in developing countries to make electricity affordable to the poor and improve electricity access. Vivien & Yepes (2006) reveal that up to 70 per cent of households in India and Africa could have expected to have difficulties in paying full costs recoveries for electricity. Similarly, 50 per cent of lower income Latin American Countries would also face difficulties were subsidies to be removed.

## 2.8 Equity and Subsidies

The equitability of electricity subsidies is ascertained by establishing the relative benefits that accrue to households distinguished by their relative income levels, a case of vertical equity. According to the World Bank (2010), the social performance of an energy subsidy can be evaluated from three stand-points: how well subsidies comparatively benefit poor households, or benefit incidence; the proportion of poor households receiving the subsidy, or beneficiary incidence; and the size or materiality of the subsidy to poor households. The extent to which electricity subsidies are vertically equitable can be evaluated by how well the poor are targeted (Bacon, et. al., 2010, p. 10).

Vertical equity in electricity access is therefore pertinent in the Uganda since only 12 per cent of the country is connected to the national grid, largely in relatively wealthier urban areas. The benefits of electricity price subsidies therefore accrue to better-off income segments of the Ugandan population. Limited electricity access is characteristic of developing countries as the Uganda case does not differ significantly from the rest of sub-Saharan Africa, which recorded electricity access in sub-Saharan Africa at only 17 per cent, with rural arrears access housing most of the population only at 5 per cent (Ogunlade & Mwakasonda, 2004).

Komives et. al. (2006) empirically establishes that the distributional incidence of electricity subsidies delivered through electricity tariffs, has been found to be regressive. This is even aggravated for quantity-based subsidies that are most highly regressive. While geographically or means-tested subsidies are found to be progressive, limited rural

electricity access leaves many poor households excluded, hindering the effectiveness of consumption subsidy schemes.

Hope & Singh (1995) reveal that the impact of subsidies on various household income levels depends on energy's share in the household budget and its price elasticity of demand. Their study contends that electricity share of household budgets decline at higher income level. In addition, they established that energy consumption increases with incomes. This suggests that end-user electricity subsidies benefit wealthier households more. The removal of electrical subsidies in this circumstance would restore income parity between income segments of the population. However, the higher share of electricity in lower income household budgets leads to lower benefits accruing to them, if subsidies were to be removed, without alternative measures being instituted to protect them. Interventions for lower income households could be based on lifeline charges for minimal thresholds of consumption, above which subsidies would not be applicable.

## **2.9 Definition and Characteristics of Subsidies**

In order to assess the costs and benefits of electricity subsidies in Uganda, a clear understanding of the definitions of subsidies needs be established. Clarity from the literature is important in guiding the research in quantifying electricity subsidies.

Electricity subsidies are defined from both a broad and specific standpoint. Broadly stated, any measure that keeps electricity prices for consumers below market-clearing levels, or in the alternative, above market levels for electricity producers is considered a subsidy (United Nations, 2003). Other broad definitions of subsidies refer to any policies that decrease energy prices or production costs through some form of unrequited value transfer

to economic agents (World Bank, 2010, p.8). Other literature, however, provides more specific definitions of subsidies that permit adequate assessment and measurement. Kosmos (1987, p. 7) makes a distinct difference between economic and financial subsidies. Financial subsidies result from Government payouts to cover operating costs, to which tax rebates on fuel imports used for electricity generation. This is distinct from the definition of economic subsidies which includes the “opportunity costs of foregoing transactions at higher market prices (Kosmos, 1987, p.7). Kitson et al. (2011, p. 13) also identifies financial subsidies as all forms of financial support, including tax incentives, that accrue to electricity generation. The investigation uses financial subsidies in assessing the impact of electricity subsidies in Uganda, as they are more easily measurable.

## **2.10 Conclusion**

The literature reviewed raises the need for consideration of the conditions and limits under which subsidies could be instituted. The arguments for and against the provision of subsidies enumerated above motivate the investigation of conditions under which subsidies were necessary in the Uganda context. The context of the investigation is the drawback that arises with the maintenance of electricity subsidies leading to significant impact on public finance and undesirable electricity consumption patterns. The relative costs and benefits of electricity subsidies therefore, need to be examined, before any conclusion is made on their consequences on overall social welfare.

### **3 RESEARCH METHODOLOGY**

#### **3.1 Research Approach**

The study used a quantitative approach to answer the research questions that were posed. The investigation relied on theory to explain the observations that have been made with respect to the Uganda electricity subsidy experience. The theory enables the deduction of hypotheses to be tested, which in turn enables the evaluation of the outcome of the investigation. The findings of the investigation enable views about the applicability of the theory in the specific Ugandan circumstance to be drawn.

#### **3.2 Research Strategy and Design**

##### **a) Research Design**

The research sought to establish the justification of incurring the electricity subsidies between 2005 and 2012 in order to support industrial output and to maintain an necessary government revenues. The research design is premised on the fact that Industrial Output provides a source of tax revenue to meet public spending needs. Industrial output is therefore related to public revenues. An Ordinary Least Squares (OLS) multiple regression model was therefore used.

The other aspect of the research sought to establish vertical equity with respect to the beneficiaries of the subsidies in relation to the income levels. The research approach to evaluating equity aspects of electricity subsidies ideally assesses the benefit incidence resulting from the product of the share of connected poor households that receive subsidies and the average rate of subsidization (World Bank, 2010). While beneficiary incidence is usually based on household level data, the study used the ability to generate profitable surplus by the top 1000 taxpayers in Uganda as an indication of income level,



in comparison to the level of electricity subsidy amounts received by industrial consumer categories.

The research therefore seeks to establish the relationship between electricity subsidies provided to industrial categories relative to the level of corporate income tax paid, in order to assess the extent of vertical equity. Corporate Income is used as a proxy to reflect the income levels of enterprises for which production data has been reported. The corporate income tax paid by respective subsectors of the economy is also a reflection of the profitability of the economic activity which they have been engaged in. The research investigated the relationship between the level of corporate income tax paid to the electricity subsidies received by respective subsectors. This enabled the provision of an insight into the level of the vertical equity in the provision of electricity subsidies, given qualitative studies that have noted electricity as a major constraint to economic activity.

In addition, the investigation evaluated the equity aspects of the electricity subsidization policy from the perspective of cross subsidies among electricity consumer categories. This does not detract from the regressive nature of electricity subsidies arising from the fact that electricity price subsidies benefit better off segments of the Ugandan population connected to the national grid.

## **b) Research Questions and Hypothesis**

The research questions that arise from the above strategy are the following:

1. What is the relationship between tax revenue collections from Uganda's industrial sector and electricity subsidies largely provided to the industrial subsector?

2. How equitable have electricity subsidies been in relation to the incomes of beneficiaries?

The research is restricted to an investigation of financial, rather than economic subsidies given the dearth of data on economic subsidies. The research is predicated on the prepositions that electricity subsidies have been necessary for the maintenance of public revenues and industrial output in Uganda. The dependent variable is public revenues. Electricity subsidies and industrial output are the independent variables. A further proposition is that targeted electricity subsidies are not equitable between end-user beneficiaries.

The hypotheses for this research are therefore as follows:-

H01: Government revenues are not affected by electricity subsidies and industrial output.

H02: High Income electricity users are not affected by electricity subsidies

### **3.3 Model Estimation**

#### **3.3.1 Model 1: Excise Tax Revenues and Electricity Subsidies**

In Model 1 focuses on the effect of electricity subsidies and industrial output on government revenues, in order to answer the research questions pertaining to the relationship between these variables. From a logical standpoint, Model 1 postulates that Excise Tax Revenues are a function of Industrial Output and Electricity Subsidies. The selection of these explanatory variables to Excise Tax Revenues is made based on the assertion that electricity subsidies were necessary to support industrial production in

Uganda from 2005. Furthermore, the logical relationship between government revenues and excise taxes as taxes on industrial output is pertinent, given that 30 per cent of government revenues in Uganda are from the manufacturing sub-sector alone.

Regression Model 1 is the regression model used to test the hypothesis of the relationships between the Electricity Subsidies and Excise Tax Revenues. The study assumes that the variables in Model 1 are stationary; therefore, a simple OLS model may be adequate to explain the relationship.

Model 1 is a three variable regression function represented as:-

$$ETR = b_0 + b_1 IO + b_2 IES + b_3 ES + e$$

The variables of the basic model are described as follows:-

**ETR:** represents Excise Tax Revenues, which is the dependant variable in the model

**IO:** represents The Index of Industrial Production, which is the dependant variable in the model

**IES:** represents Industrial Electricity Sales, which is the dependant variable in the model

**ES:** represents Electricity Subsidies, which is the dependant variable in the model

**$b_0$ :** represents the regression intercept coefficient

**$b_1$ :** represents the co-efficient of the Industrial Output variable

**$b_2$ :** represents the co-efficient of the Industrial Electricity Sales variable

**$b_3$ :** represents the co-efficient of the Electricity Subsidy variable

**$e$ :** represents the regression error term

### 3.3.2 Model 2: Corporate Tax Revenues and Electricity Subsidies

In Model 2, the study investigates the relationship between Annual Fiscal Year Electricity Subsidies and Annual Fiscal Year Corporate Tax Revenues. Annual corporate revenues are used in Model 2 as collections of corporate taxes are seasonal, with collections largely being registered at the end and middle of the fiscal year. Model 2 seeks to establish evidence for the overall profitability of the manufacturing sub-sector over the period under investigation, since the electricity subsidies disproportionately favoured industrial end-users. Evidence of the ability of the manufacturing sector to make profit, and therefore meet Corporate Income Tax obligations is a necessary condition to establish the conclusion of the vertical equitability or lack thereof. This is pertinent in view of the subsidy provision benefits disproportionately the larger end-user electricity consumers.

The study assumes that the variables used in Model 2 are stationary; therefore, a simple OLS model may be adequate to explain the relationship.

Model 2 is a two variable regression function represented as:

$$ACTR = b_0 + b_1AIES + b_2AES + e$$

***ACTR***: represents Annual Corporate Tax Revenue collections from the manufacturing sub-sector, which is the dependant variable in the model

***AIES***: represents Annual Fiscal Year Industrial Electricity Sales, which is a dependant variable in the model

***AES***: represents Annual Fiscal Year Electricity Subsidies, which is a dependant variable in the model

***b<sub>0</sub>***: represents the regression intercept coefficient in Model 2

$b_1$ : represents the co-efficient of the Annual Fiscal Year Industrial Electricity Sales variable in the model

$b_2$ : represents the co-efficient of the Annual Fiscal Year Industrial Electricity Subsidies variable in the model

$e$ : represents the regression error term in the regression model

### **3.4 Data Collection, Frequency and Choice of Data**

The study used secondary data collected mainly from official Ugandan agency sources. secondary data collected from the Bank of Uganda, the Uganda Revenue Authority (URA), the Uganda Bureau of Statistics (UBOS) and Ministries of Finance, Planning and Economic Development (MFPED) and that of Energy and Mineral Development. Data was also obtained from the main electricity distribution segment concessionaire, Umeme Limited. Data for the research includes quarterly data between 2005 and 2011 for the following data variables:-

1. End-User Subsidies data from the Uganda Electricity Regulatory Authority (ERA)
2. Excise and Corporate Tax Revenue Collections from the Uganda Revenue Authority (URA)
3. Formal Manufacturing Sub-Sector Production Data from the Uganda Bureau of Statistics (UBOS)

The investigation undertook an analysis of secondary data obtained from official sources in order to investigate the relationships between key variables during the period under investigation. These variables are excise and corporate tax revenues, in the two models

which respectively represent the benefits to society for the former, and to a specific high income group of interest in the investigation of vertical equity in the latter case.

The Excise Tax Revenue variable is a proxy for societal benefits, as excise taxes translate into a source for spending on public goods and social welfare. The Excise Tax variable served as the dependant variable in model investigating the costs and benefits of electricity subsidies. The dependant variables comprised of Industrial output, which is the basis for excise tax revenues; industrial energy sales, and electricity subsidies.

Electricity subsidies in the model were treated as a cost to society to the extent that they directly represent a reduction in the amount available for social spending, if they do not contribute to an increase in societal benefits.

### **3.5 Sampling**

The investigation used both quarterly and fiscal year revenue data and quarterly production indices from Uganda's manufacturing sub-sector. Electricity subsidies data was obtained from quarterly data provided by the Electricity Regulatory Authority during the period under investigation. The electricity subsidies are indicated for domestic, commercial medium and large consumer categories, in addition to street lighting and very large industrial concerns for which data is insignificant or no subsidy provision had been made.

While the subsidy provisions for each end-user category were provided for *apriori* in ERA's Quarterly Tariff announcements, actual provisions differed substantially from provisions during subsidy implementation. Invariably, medium and large industrial end-

user consumers received disproportionately larger portions of the subsidy. Twenty one out of a total of the thirty observations of industrial end-user subsidy provisions over the period under investigations, revealed an average share of 63 per cent accruing to industrial consumers, with a range range from 59 per cent to 95 per cent of the entire subsidy provision (see Appendix ). This reflects significant levels of cross subsidisation among beneficiaries of subsidies. The provision of larger electricity subsidies to medium and large industrial consumer categories disproportionate to other domestic and commercial electricity consumers provides a greater, though partial understanding of the relationships being investigated.

### **3.6 Data Analysis**

In this analysis, primary emphasis was placed on the distinctive impact of electricity subsidies and excise and corporate tax revenues. The Excise Tax variable was used a proxy for the benefits to the society. Corporate Tax Revenue was used as a proxy for the ability to pay in investigating the extent of vertical equity. After data collection, data was entered into Excel and analysis done using Excel's Data Analysis tool.

The method that was employed in the data analysis is a regression analysis of the data variables to establish relationships between them (Gujarati (1999; 2003). The approach sought to establish any relational aspects from which explanations could be induced.

Key to the analysis was the evaluation of the results of the regression using statistical tests to determine how best the results explain the theoretical underpinnings of the investigations. Each of the research questions was evaluated. An overall conclusion was induced from the results of the regressions evaluation.

The evaluation of the results sought to confirm of goodness of fit of the regression to the estimated model and the statistical significance of the estimated parameters of the model. Checks of goodness of fit was assessed using the R-squared analyses of the pattern of residuals and ultimately, tested the hypotheses postulated. The statistical significance of the model was checked by an F-test for the regression model's overall fit, in addition to t-tests of individual estimators.

### **3.7 Limitations**

The research may be limited by the availability of data on all the variables on a quarterly basis to enable sufficient number of observations to allow useful econometric analysis using time series regression analysis.

The research is also limited to assessing equitability among categories of electricity consumers using benefit incidence to investigate the relative impact of electricity subsidies on different categories of electricity consumers in order to determine the equitability or lack thereof of the electricity subsidy policy in Uganda.

Adams et. al. (2004) notes several disadvantages of secondary data that have become manifest during the investigations. These include:

1. Data Compatibility:- The lack of data compatibility, arising from the available information not matching what is required for the investigation.
2. Data coverage:- The inadequacy of the data and information to cover all subjects or groups in the investigation.



3. Data In-availability or Lack of Depth: Obtaining early period data was problematic with inadequacies that required omission of odd data to enable understanding of the effect on investigation.
4. Data Consistency: the data and information was not available from all time periods as would have been desired in the design, making comparisons difficult.

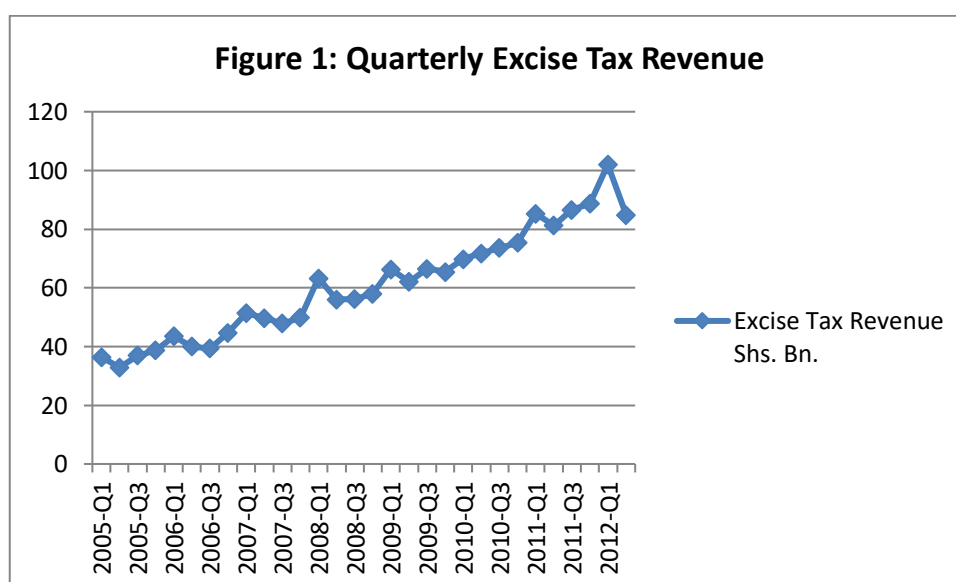
## 4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

### 4.1 Introduction

The empirical results of the regression models are presented and statistically evaluated to ascertain the adequacy and performance of the model. The effects of electricity subsidies on government revenues is assessed, and thereafter the effects of the control variable industrial electricity sales on government outputs. The hypotheses are then tested against empirical results.

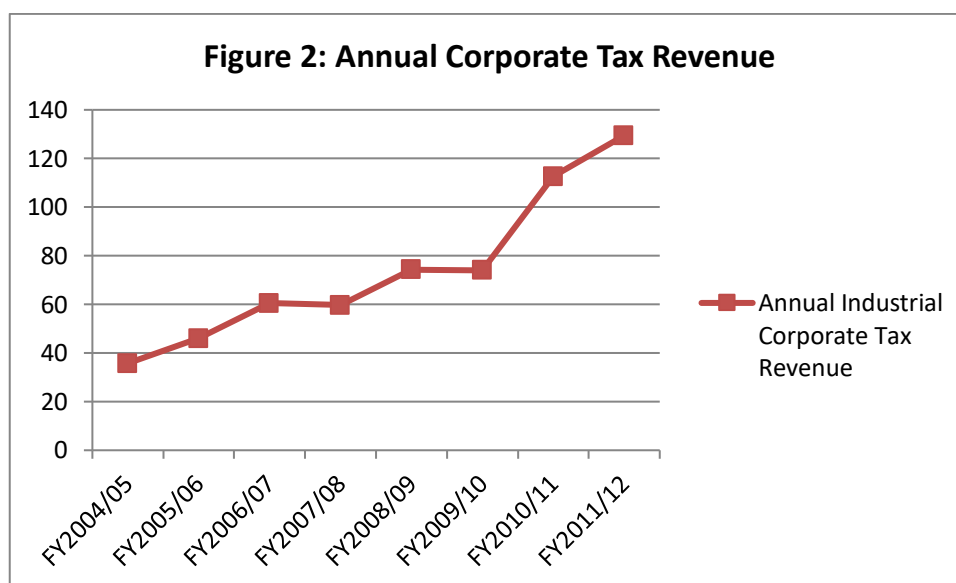
### 4.2 Descriptive Statistics

The analysis below provides an empirical view of the performance of the Uganda industrial output, electricity subsidies and corporate and excise government revenues during the period.



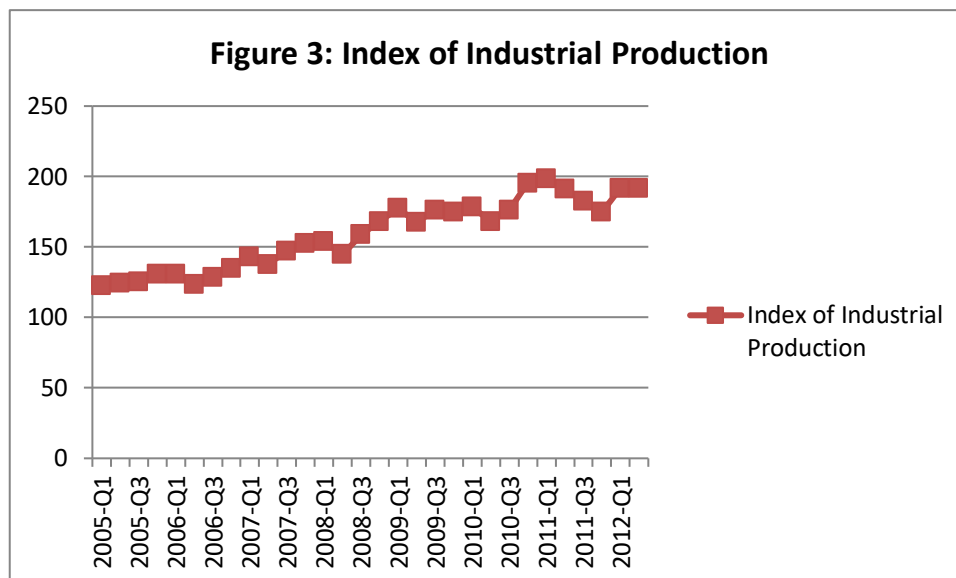
*Source: Uganda Revenue Authority*

Figure 1 generally depicts an increasing trend in excise tax revenue collections for the entire period under investigation. Seasonality in excise tax collections is observed, with distinct peaks in collection in the first quarter of most of the years. This reflects increased responsiveness of excise taxes to increased production observed during the end of year period.



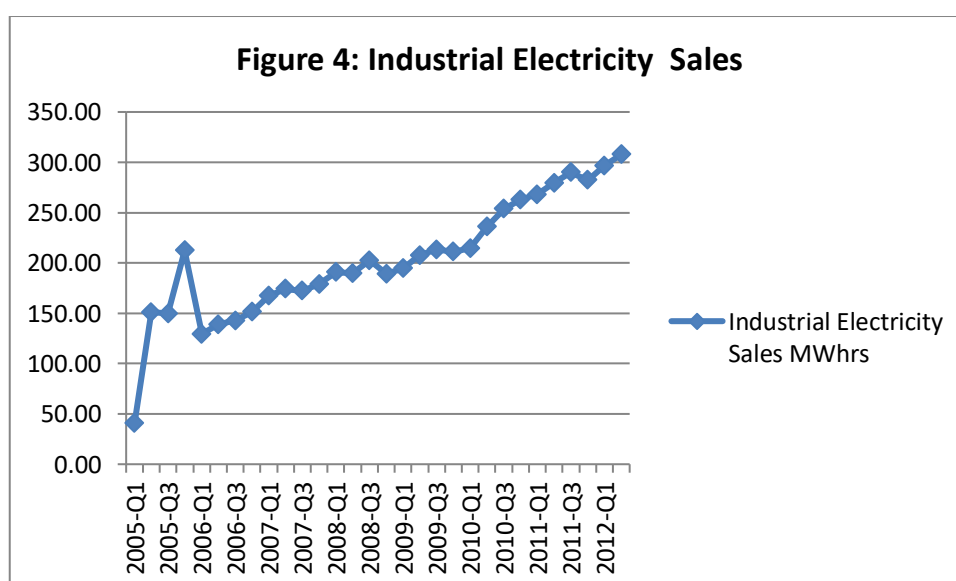
**Source: Uganda Revenue Authority**

Corporate tax revenues depict an increasing trend during the period as shown in Figure 2. It is noteworthy that an increasing trend in corporate tax collections is recorded in the later periods of the investigations, showing the increased profitability of



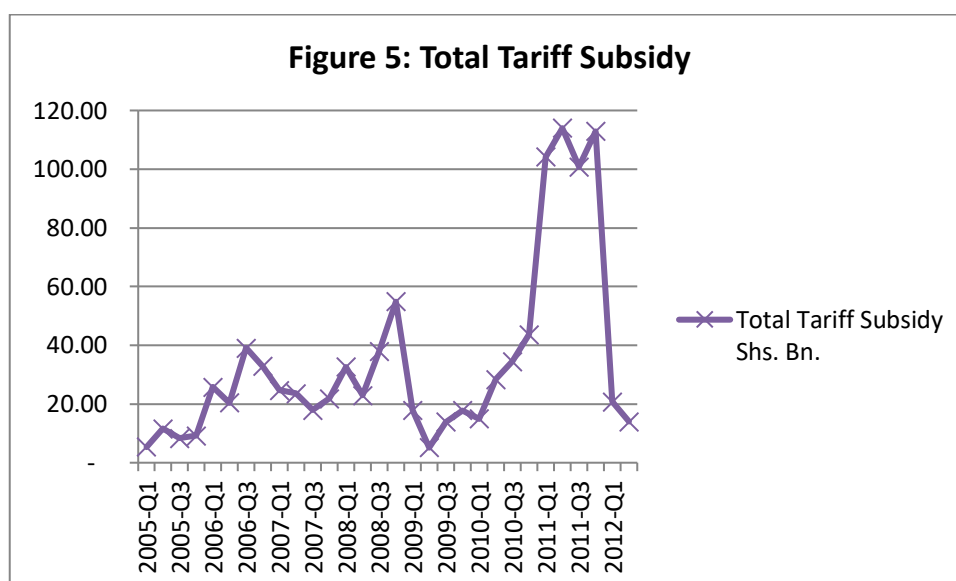
**Source:** Uganda Bureau of Statistics

The Index of Industrial Production shows an increasing trend over the period under investigation. From a general standpoint, it reveals that industrial output increased over the period without marked deceleration in industrial output growth. Of interest to the investigation is the extent to which this increasing growth in industrial output is related to the provision of electricity subsidies to the industrial sector.



**Source:** Umeme Limited

Figure 4 shows that Industrial electrical sales exhibited an increasing trend over the period under investigation. The figure reveals that electricity sales to the industrial subsector were maintained at an increasing trend. It suggests that Government's electricity subsidization policy was successful in availing electricity for industrial production. The extent of the relationship between industrial electricity sales and subsidies would enable the understanding of the role of subsidies in maintaining industrial electricity sales.



**Source:** Electricity Regulatory Authority

The total electricity subsidy depicts an overall increase during the period though with significant fluctuations.

The summary statistics of the data used in the study are presented in Table 1 below.

**Table 1: Model 1 Summary Statistics**

	<i>ETR</i>	<i>CTR</i>	<i>IES</i>	<i>IOP</i>	<i>ES</i>
Mean	60.8291	72.9070	203.3271	159.0929	34.4021
Standard Error	3.3623	11.8898	10.8932	4.5177	5.7609
Median	60.0918	53.2081	198.5588	163.1748	23.2343
Standard Deviation	18.4160	65.1229	59.6643	24.7444	31.5537
Sample Variance	339.1492	4240.9885	3559.8288	612.2852	995.6365
Kurtosis	-0.7441	1.0250	0.5067	-1.3885	2.0014
Skewness	0.3472	1.2283	-0.2737	-0.0498	1.7452
Range	69.1314	236.4438	267.0140	75.9812	108.8306
Minimum	32.8647	7.4653	40.6810	122.4735	5.1311
Maximum	101.9962	243.9091	307.6950	198.4547	113.9618
Sum	1824.8721	2187.2102	6099.8122	4772.7867	1032.0625
Count	30.0000	30.0000	30.0000	30.0000	30.0000
Confidence Level(95.0%)	6.8766	24.3173	22.2790	9.2397	11.7823

Kurtosis measures suggest standard normal distributions for the variables used in the investigation, except for the Electricity Subsidies variable.. The standard normal distributions for the variables is further reinforced by the low level of skewness around zero for the all the variables with the exception of electricity subsidies variable. The relatively higher kurtosis and skewness of the Electricity Subsidy variable reveals the extent of its variability.

### 4.3 Effects of Electricity Subsidies on Excise Tax Revenues

#### 4.3.1 Model 1's Empirical Results

**Table 2: Excise Tax Subsidy Model (Model 1) Regression Results**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-32.9120	8.8271	-3.7285	0.0009
IES	0.1036	0.0387	2.6789	0.0126
IOP	0.4464	0.0903	4.9435	0.0000
ES	0.0481	0.0418	1.1512	0.2601
R Square	0.904	Adjusted R Square		0.8928
Durbin Watson				
<i>F-Statistic</i>	81.472	<i>F (Prob)</i>		2.4E-13

Regression results in Table 2 suggest that the independent variables explain about 89.3% of the variations in the dependent variable. The probability of the F-statistic (0.0000) shows that the model was not very perfectly specified but there is no statistical evidence to justify misspecification.

The regression gives a short-term of Model in the form:-

$$ETR_{2005-11} = -32.91 + 0.1036 IES + 0.4464 IOP + 0.0481 ES$$

(2.6789)                      (4.9435)                      (1.1215)

The empirical results in Table 2 suggest a positive relationship between Excise Tax Revenues, Industrial Energy Sales and Electricity Subsidies. The results of the estimation reveal a positive relationship between the performance of excise tax revenues on the one hand, and electricity subsidies and industrial output, on the other.

It suggests that a unit increase in excise tax revenues was related to a 10.4 percent increase in Industrial Electricity Sales (IES); a 44.6 per cent increase in Industrial Output (IOP) and a 4.8 per cent increase in Electricity Subsidies (ES) during the period under observation.

Based on the estimators of the Electricity Subsidies variable, there is sufficient evidence to infer that the Electricity Subsidies is linearly related to Excise Tax Revenues. Electricity Subsidies have significant effects in Model 1, which is logically acceptable, as it conforms to *a priori* expectations. The large t-statistic value for the Electricity Subsidies coefficient (1.1215) relative to its coefficient value (0.0481) suggests that the null hypothesis can be rejected. The large values of t-statistic for the Electricity Subsidies and

Industrial Output relative to their respective co-efficients indicates that the corresponding coefficient is not zero and therefore that the null hypothesis can be rejected.

Furthermore, the probability values for the t-statistics of the respective coefficient are small, providing further evidence that respective coefficient is non-zero. Specifically, the probability of the estimator for electricity subsidies is relatively small (0.2601), which is further evidence that the coefficient is not zero. It can be concluded, therefore that electricity subsidies affected excise tax revenues during the period under investigation.

#### **4.3.2 Test of Model 1's Validity**

The regression's coefficient of determination which indicates the goodness-of-fit of Model 1 is very significant with an  $R^2$  of 90.4 per cent. The co-efficient of determination indicates the very high explanatory power of the model of the relationship between Excise Tax Revenues, Electricity Subsidies and Industrial Output. In addition, the adjusted coefficient of determinations, which penalizes the model for any excess of the number of regressors that do not add to the explanatory power of the regression (adjusted  $R^2$ ), is quite close to the R-squared at 89.3 per cent. Model 1 significantly explains a very high proportion of the variation in those outputs, leaving a small portion unexplained. This suggests that the model is reasonable to a very large extent.

The F-statistic of the model is significant at one percent significance level, as it is close to zero, providing confidence that the model fit the data generally well. The large F-value (81.472) suggests that the evidence is inconsistent with the null hypothesis, providing grounds for its rejection. The probability (p-value) of the F value ( $2.4 \times 10^{-13}$ ) is sufficiently smaller than the significance level of 1 percent, allowing the null hypothesis to be rejected, and consequently the acceptance alternative hypothesis. This further



suggests that electricity subsidies positively affected excise tax revenue collections during the period under investigation.

The Standard Error of Estimates (S.E) of each of the variable Model 1 are particularly small compared to the means of the dependent variables. This gives the assurance that the model is fairly good enough for making accurate and meaningful conclusions.

#### 4.4 Effects of Electricity Subsidies on Corporate Tax

##### 4.4.1 Model 2's Empirical Results

**Table 3: Regression Results using Corporate Taxes**

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	8.2480	12.9677	0.6360	0.5527
AIES	0.0621	0.0253	2.4578	0.0574
AES	0.1480	0.0851	1.7392	0.1425
R Square	0.9047	Adjusted R Square		0.8665
F	23.7193	Significance F		0.0028

The short form of Model 2 can therefore be represented as follows:-

$$ACTR_{2005-11} = 8.248 + 0.0621AIES + 0.1480 AES$$

(2.4578)                      (1.7392)

The empirical results of the estimates in Model 2 suggest that there is sufficient evidence to infer that the Electricity Subsidies positively affected Corporate Tax Revenues paid by the Uganda manufacturing sub-sector during the period under investigation. This suggests that the sub-sector receiving the larger share of electricity subsidies was sufficiently profitable during the period under investigation. The relatively large t-statistic value for the Electricity Subsidies coefficient (1.7392) compared to its coefficient value (0.1480) suggests that the null hypothesis can be rejected. Therefore it can be concluded electricity

subsidies affected Corporate Tax revenues from the manufacturing sub-sector, thereby accepting the alternative hypothesis. The probability of the estimator for electricity subsidies is very small (0.1425) which can be taken as evidence that coefficient is non-zero.

The empirical results suggest a positive relationship between Annual Corporate Tax Revenues paid by the manufacturing sub-sector, Annual Industrial Energy Sales and Annual Fiscal Year Electricity Subsidies. Table 2 shows a positive relationship between Corporate Income Tax revenues and electricity subsidies. It suggests that a unit increase in Corporate Income Tax revenues was related to a 14.8 percent increase in electricity subsidies (ES) and a 6.2 per cent increase in Industrial Energy Sales (IES) during the period under observation.

#### **4.4.2 Test of Model 2's Validity**

The regression's coefficient of determination for the Model 2, which reflects the 'goodness-of-fit' of the regression is very significant with an  $R^2$  of 90.5 per cent. The coefficient of determination indicates the very high explanatory power of the model of the relationship between Corporate Tax Revenues, Electricity Subsidies and Industrial Energy use. The adjusted coefficient of determination (adjusted  $R^2$ ) is also very high and close to the R-squared at 86.7 per cent. The model significantly explains a very high proportion of the variation between the variables, leaving a small portion unexplained. This suggests that the model is largely reasonable.

The F-statistic of the model is significant at one percent significance level, as it is close to zero, providing confidence that the model fit the data generally well. The large F-value (23.7) suggests that the evidence is inconsistent with the null hypothesis, providing

grounds for its rejection. The probability (p-value) of the F value (0.003) is smaller than the significance level of 1 percent for the null hypothesis to be rejected, and consequently the acceptance alternative hypothesis. This therefore suggests that electricity subsidies positively affected excise tax revenue collections during the period under investigation.

The Standard Error of Estimates (S.E) of the dependent variables in Model 2 model are small compared to the means of the dependent variables. This gives the assurance that the model is fairly good enough for making accurate and meaningful conclusions.

The large values of t-statistic for the Annual Electricity Subsidies and Industrial Electricity Sales relative to their respective co-efficients indicates that the corresponding coefficient is not zero and therefore that the null hypothesis can be rejected. Furthermore, the probability values for the t-statistics of the respective coefficient are small, lending further evidence that respective coefficient is non-zero.

## **5 RESEARCH CONCLUSIONS**

The study sought to investigate the relationship between electricity subsidies, on the one hand and industrial output and government revenues in Uganda between 2005 and 2011 when electricity subsidies were pervasive. It also sought to ascertain the equitability of the electricity subsidy policy in view of limited electricity access across the country, and also because the subsidies were beneficial to larger industrial end-users. Excise Tax revenues, as a tax on industrial production, were used as a proxy for revenue performance in order to assess the effect of subsidies on overall revenue performance. An investigation of the relationship between corporate tax collections from the manufacturing sub-sector, and electricity subsidies was undertaken, to assess the equitability of the policy. Corporate taxes were used as a proxy for the well-being of beneficiaries.

Electricity subsidies were found to have positively affected both excise and corporate tax revenues and industrial output during the period under study. From the evidence, the overall objective of the electricity subsidy policy seems to have been attained, in as far as revenues base was protected and industrial output was maintained.

The evidence also reveals that at a macro-level, electricity subsidies were positively related to end-user corporate tax revenues of the manufacturing sub-sector. This reveals that better off firms continued to make profits, enabling them meet their corporate tax obligations.

## **6 RECOMMENDATIONS FOR FUTURE RESEARCH**

The evidence from the investigation shows that subsidy policy needs to be implemented after a careful study of the timing and targeted beneficiaries for the policy. Subsidy policy needs to be smarter to match the provision of the subsidy and the gap that needs to be addressed. This ultimately enables the minimization of the leakage of revenues that would otherwise be available for priority spending.

The extent to which subsidy support could have been withdrawn to restore income parity between higher income end-users and the rest of the population needs to be further studied from a micro-level standpoint. Better targeting of subsidies ensures that they are provided to parties who need them. This will enable the subsidy policy to ensure vertical equity and not provide undue benefits to segments of the population, who have the ability to pay.

## REFERENCES

1. Amegashie J. A, 2006. The Economics of Subsidies, University of Guelph, Canada. Retrieved from [www.uoguelph.ca/~jamegash/research.htm](http://www.uoguelph.ca/~jamegash/research.htm).
2. Borenstein S. and Holland, S. P., 2003. On the efficiency of Competitive Electricity Markets with Time -Variant Retail Prices, Working Paper No 9922, National Bureau of Economic Research Cambridge, MA 02138. Retrieved from <http://www.nber.org/papers/w9922>
3. Bank of Uganda, 2006, Annual Report
4. Dufty, G. ,2007. 'Electricity pricing: delivering social justice and environmental equity; St Vincent de Paul Society Victoria Inc.
5. Electricity Regulatory Authority, 2012. Annual Report
6. Foster, V. & Yepes, T., 2006. Is Cost Recovery a Feasible Option for Water and Electricity? The Latin American Experience. The World Bank Policy Research Paper No. 3943, June 2006.
7. Jamil, F. and Ahamad, E. 2010. The relationship between electricity consumption, electricity prices and GDP in Pakistan. Energy Policy 38 (2010) 6016 -6025
8. Kitson L, Wooders P. and Moerenhout t., 2011. Subsidies and External Costs in Electric Power Generation: A comparative Review of Estimates, Global Subsidies Initiative, 2011. Manitoba, Canada. Retrieved from [http:// www.iisd.org/gsi](http://www.iisd.org/gsi).
9. Lipsey and Lancaster, 1956. The General Theory of Second Best cited in J. Atsu Amegashie (2006) The Economics of Subsidies
10. Kenneth A. and Debreu G. , 1954, , cited in J. Atsu Amegashie (2006) The Economics of Subsidies
11. Bacon R., Ley E., and Kojima M., 2010. Subsidies in the Energy Sector: An Overview. Background Paper for World Bank Group Energy Sector Strategy, The World Bank
12. Kitson, L., Wooders, P., and Moerenhout, T. 2011. Subsidies and External Costs in Electric Power Generation: A comparative Review of estimates. The International Institute for Sustainable Development, September 2011.

13. Kerkela, L., 2004. Distortion Costs and Effects of Price Liberalisation in Russian Energy Markets: A CGE Analysis, Bank of Finland Institute for Economies in Transition Discussion Paper 2/2004
14. Kosmos, M., 1987. Money to Burn? The High Costs of Energy Subsidies, World Resources Institute , Washington D.C
15. Gujarati, D., 1999. Essentials of Econometrics, Second Edition, Irwin McGraw-Hill
16. Gujarati, D., 2003. Basic Econometrics, Fourth Edition, McGraw Hill
17. Hope E., & Singh, B., 1995. Energy Price Increases in Developing Countries. World Bank Policy Research Working Paper No. 1442. The World Bank, Washington D.C.
18. Ministry of Finance, Economic Development (2011). Impact of Energy Supply Constraints on the Economy.
19. Ministry of Energy and Mineral Development (2011) Statistical Abstract
20. Ogunlade D. & Mwakasonda S. A. , 2004. Electricity Access for the Poor: A Study of South Africa and Zimbabwe in Energy for Sustainable Development, Vol VIII No.4 December 2004.
21. Ritschel A. and Smestad G.P., 2003. Energy Subsidies in California's Electricity Market De-regulation. Energy Policy 31(2003) 1379 -1391
22. Saboohi, Y. 1999. An Evaluation of the Impact of reducing energy subsidies on living expenses of households. Sharif Energy Research Institute, November 1999. Energy Policy No 29 (2001) Pg 245 – 252.
23. Stiglitz, J.E., 2000. Economics of the Public Sector, Third Edition, (New York, W.W. Norton & Co.
24. Stiglitz, J. E., 2002. Globalisation and its Discontents, Penguin Books, London United Kingdom.
25. Uganda Bureau of Statistics, 2012, Statistical Abstract, Uganda Bureau of Statistics, June 2012.
26. United Nations, 2003. Energy Subsidies: Lessons Learned in Assessing their Impact and Designing Policy Reform, United Nations Environmental Programme

## APPENDICES



## Appendix 1: Regression Results of Excise Tax Revenues, Industrial Sales and Electricity Subsidies

### SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.950711
R Square	0.903852
Adjusted R Square	0.892758
Standard Error	6.03085
Observations	30

<i>ANOVA</i>				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	3	8889.678	2963.226	81.47189
Residual	26	945.6498	36.37115	
Total	29	9835.328		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 99.0%</i>	<i>Upper 99.0%</i>
Intercept	-32.912	8.827094	-3.72853	0.000945	-57.4400231	-8.384073332
Industrial Electricity Sales MWhrs	0.103634	0.038685	2.67888	0.012638	-0.00386214	0.211129518
Index of Industrial Production	0.446373	0.090295	4.943489	3.9E-05	0.195468782	0.697278093
Total Tariff Subsidy Shs. Bn.	0.0481	0.041782	1.151223	0.260118	-0.06799948	0.164199699

## Appendix 2: Regression Results of Corporate Income Tax Revenues and Electricity Subsidies

<i>Regression Statistics</i>	
Multiple R	0.9511311
R Square	0.9046503
Adjusted R Square	0.8665104
Standard Error	11.71352
Observations	8

<i>ANOVA</i>					
	<i>Df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	2	6508.8793	3254.4397	23.719272	0.0028074
Residual	5	686.03278	137.20656		
Total	7	7194.9121			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 99.0%</i>	<i>Upper 99.0%</i>
Intercept	8.2480019	12.967678	0.6360431	0.5527188	-44.039532	60.535536
Fiscal Year Industry Electricity Sales	0.0620929	0.0252638	2.4577812	0.0573848	-0.0397744	0.1639602
Fiscal Year Electricity Subsidies	0.1479982	0.0850976	1.739158	0.1424995	-0.1951275	0.4911238

### Appendix 3: Quarterly Data used for Model 1

Period	Excise Tax Revenue Shs. Bn	Corporate Tax Revenue Shs. Bn	Industrial Electricity Sales MWhrs	Index of Industrial Production	Total Tariff Subsidy Shs. Bn.	Industrial Electricity Subsidies Shs. Bn.
2005-Q1	36.48810635	21.30192959	40.68	122.4734972	5.37	2.57
2005-Q2	32.86473084	56.58629267	150.97	124.5518303	11.56	6.26
2005-Q3	36.98472066	21.329096	149.78	125.5243632	8.30	4.76
2005-Q4	38.69489727	70.50701771	212.45	130.7755875	9.24	5.13
2006-Q1	43.51996668	8.671439429	129.43	130.9320377	25.79	15.23
2006-Q2	40.08232783	81.66629906	138.96	123.809757	20.44	14.04
2006-Q3	39.36561046	7.465250421	142.65	128.5046306	39.11	25.13
2006-Q4	44.76449189	78.91271504	151.23	134.9777865	32.89	24.52
2007-Q1	51.41544064	12.81455395	167.45	143.0536905	24.72	23.37
2007-Q2	49.79056502	95.81257631	174.34	137.7769027	23.55	16.97
2007-Q3	47.84234428	14.886371	172.42	147.2272448	17.95	n/a
2007-Q4	49.81827482	95.96665606	179.07	152.702614	21.85	n/a
2008-Q1	63.22597811	14.88174414	190.73	153.8327396	32.63	n/a
2008-Q2	56.06962145	87.56335931	189.84	144.8204192	22.92	n/a
2008-Q3	56.14572479	9.977204278	202.63	158.8942785	37.97	n/a
2008-Q4	58.06179296	99.12090092	189.19	168.1182159	54.94	n/a
2009-Q1	66.28544584	17.96123411	194.49	177.6239744	17.94	8.494
2009-Q2	62.12172453	102.8993787	207.70	167.4553862	5.13	3.303
2009-Q3	66.51931389	18.63904963	213.36	176.131819	13.89	8.925
2009-Q4	65.422618	157.1039177	210.99	175.0991449	17.83	10.216
2010-Q1	69.84583716	30.13194629	214.73	178.3481937	14.93	11.817
2010-Q2	71.73492523	109.5038379	235.85	168.1525193	28.40	19.036
2010-Q3	73.62	49.83	253.80	176.1691987	34.49	16.733
2010-Q4	75.33	169.83	263.05	195.5492432	43.62	26.007
2011-Q1	85.33	44.11	268.04	198.4547102	104.17	62.044
2011-Q2	81.29	155.81	279.33	191.2093811	113.96	67.88
2011-Q3	86.64745697	30.12197225	289.83	182.460205	100.82	67.623
2011-Q4	88.70201507	234.2793544	282.36	174.7530251	112.87	60.107
2012-Q1	101.996157	45.61703426	296.78	191.8848249	20.77	81.38126263
2012-Q2	84.89200884	243.9090576	307.70	191.5194481	14.02	n/a

Appendix 4: [Annual Data Used in Model 2](#)

<b>Fiscal Year</b>	<b>Annual Industrial Corporate Tax Revenue</b>	<b>Annual Industry Elec Sales</b>	<b>Annual Industry Electricity Subsidies</b>	<b>Annual Industrial Corporate Tax Revenue</b>
FY2004/05	35.77875384	191.647	16.93009038	37.02232
FY2005/06	45.96721328	630.619	63.7656383	47.45119
FY2006/07	60.5130499	635.675	120.2731935	62.16962
FY2007/08	59.68917012	732.0515	95.34161852	65.76709
FY2008/09	74.30768162	794.0022	115.9862416	74.30768
FY2009/10	74.06902737	874.9329	75.04566542	74.06903
FY2010/11	112.5625286	1064.232	296.2470523	115.3036
FY2011/12	129.4469079	1176.653	213.6883907	140.922